



technology opportunity

The Spring Tire

A novel new tire innovation from NASA and Goodyear ideal for off-road terrestrial or planetary/lunar vehicles



NASA photo

Above: Spring Tires are shown here mounted to NASA's Scarab lunar roving vehicle. *Far right, top:* Current configuration of the Spring Tire, featuring interwoven, radially configured support springs and a round cross section. *Far right, bottom:* The Spring Tire conforms/deforms to the terrain to facilitate traction and reduce motion from transferring to the vehicle, enabling high speeds over rough terrain while maintaining a relatively smooth ride.



NASA photo



NASA photo

The result of a successful collaborative effort between NASA's Glenn Research Center and The Goodyear Tire and Rubber Company, the Spring Tire overcomes the load-bearing and distance limitations of tires previously used on NASA's Apollo Lunar Roving Vehicle, and offers high resiliency even when damaged, making it ideal for harsh terrestrial environments on Earth. The tire contains load-bearing helical springs, requires no air or rubber, and uniquely contours to the terrain surface while consuming less energy than other tires. Because it is constructed without any air or rubber, the tire can be used in the harsh temperature extremes of space and as a safer alternative for military and off-road vehicles in which traditional pneumatic tires can fail when hit by bullets or driven over sharp terrain.

Benefits

- **Robust:** Operation continues even with damage to multiple springs, unlike rubber-based tires that have a single point of failure upon puncture.
- **High-Performance:** The spring mesh contours to the ground surface, enabling high-speed driving over rough terrain with relatively little motion transferred to the vehicle.
- **Efficient:** Spring elements that consume minimal energy and produce little friction during deformation help reduce energy loss.
- **High-Capacity:** The unique mesh design enables high loads to be supported without overstressing the springs.
- **Long Life:** Uniformly distributing wire stresses extends the life of the tire.
- **Simplified Manufacturing:** Compared to traditional tires, the Spring Tire is extremely simple to manufacture because the helical springs are simply screwed together.

Applications

- Lunar and planetary exploration vehicles/rovers
- Off-road, harsh environment terrestrial vehicles
- Military combat vehicles

Technology Details

The Spring Tire design is an innovative, yet simple network of coiled wires designed to safely and efficiently carry vehicles over rough terrain.

How It Works

During operation, the support springs passively contour to the terrain by flexing and moving with respect to each other. These springs are interwoven radially across the tire, allowing them to deform without twisting, turning, or significantly interfering with neighboring springs. Together the springs support immense loads, but individually they flex freely to accommodate variations in terrain. The use of hundreds of decoupled springs makes the design ultra-redundant, and able to withstand damage that would be catastrophic to traditional tires.

The Spring Tire has been successfully tested on a variety of terrain using NASA's manned Lunar Electric Rover, NASA's autonomous Scarab roving vehicle, and a commercial all-terrain vehicle.

Why It Is Better

The Spring Tire overcomes limitations identified with the wire mesh tires used for the Apollo program and will enable potential future NASA missions to the Moon and other planets to use rovers and exploration vehicles designed for ten times the load capacity and one hundred times the distance of the original Apollo vehicle. In addition, the design is more versatile, enabling a simple manufacturing approach.

For both lunar/planetary exploration and Earth-based applications, the tire offers greater safety because it has no single point of failure. The tire can continue operating even when up to 25 percent of the springs have been damaged. This can be particularly useful for military vehicles subject to gunfire, shrapnel spray, or harsh off-road environments. The tire can also lower vehicle weight by eliminating the need to carry a spare tire. Finally, compared with other tires used for space exploration or off-road and military applications, the Spring Tire's novel design significantly reduces energy loss which can result in improved fuel economy.

Patents

NASA's Glenn Research Center and the Goodyear Tire and Rubber Company have applied for patent protection for this technology.

Licensing and Partnering Opportunities

Glenn's Technology Transfer and Partnership Office seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to consider licensing the Spring Tire technology (LEW-18466-1) for commercial applications.

For More Information

For information about this and other technology licensing opportunities, please visit:

Technology Transfer and Partnership Office
NASA's Glenn Research Center
E-mail: ttp@grc.nasa.gov
Phone: 216-433-3484
<http://technology.grc.nasa.gov>